

CORRES. CONTROL  
INCOMING LTR NO.

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DUE  
DATE

ACTION



Department of Energy

ROCKY FLATS FIELD OFFICE  
P.O. BOX 928  
GOLDEN, COLORADO 80402-0928

COPY

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DOE-10836  
ROCKY FLATS PLANT  
CORRESPONDENCE CONTROL

DIST.	LTR	ENC
BURLINGAME, A.H.		
BUSBY, W.S.		
CARNIVAL, G.J.		
CORDOVA, R.C.		
DAVIS, J.G.		
FERRERA, D.W.		
FRAY, R.E.		
GEIS, J.A.		
GLOVER, W.S.		
GOLAN, P.M.		
HANNI, B.J.		
HEALY, T.J.		
HEDAHL, T.G.		
HILBIG, J.G.		
HUTCHINS, N.M.		
JACKSON, D.T.		
KELL, R.E.		
KUESTER, A.W.		
MARX, G.E.		
MCDONALD, M.M.		
McKENNA, F.G.		
MORGAN, R.V.		
PIZZUTO, V.M.		
POTTER, G.L.		
SANDLIN, N.B.		
SATTERWHITE, D.G.		
SCHUBERT, A.L.		
SCHWARTZ, J.K.		
SETLOCK, G.H.		
STIGER, S.G.	X	
TOBIN, P.M.		
VOORHEIS, G.M.		
WILSON, J.M.		
Buddy, M.	X	X
Hollowell, S.	X	X

James & Holly Anderson  
14000 West 78th Avenue  
Arvada, CO 80005

RE: REPORT ON ANALYSIS OF YOUR SOIL SAMPLE - LOCATION PT 14692

Dear Mr. & Mrs. Anderson:

The Department of Energy (DOE) first wishes to thank you for allowing access to your property for soil sampling. Your cooperation is greatly appreciated and essential to this important environmental investigation.

Second, the DOE has received initial data from the soil samples taken from your property as part of the ongoing Rocky Flats Plant environmental investigation. **The surface soil concentration level from your property falls within the measured local background concentration range.**

Included in this correspondence are your laboratory analysis results (Enclosure 1), results of soil analyses from background locations for comparison (Enclosure 2), and an information sheet defining technical terms used in the explanation of the data (Enclosure 3). Also included is information on types and sources of radiation (Enclosure 4A and 4B).

Your soil analysis results represent the concentration of certain radioactive materials - plutonium, americium, and uranium - found in surface soils. Plutonium is primarily a result of artificial production; little naturally-occurring plutonium exists in the world. However, small amounts are found in soils throughout the world as a result of residual fallout from past global atmospheric nuclear weapons testing and space research. No nuclear weapons tests have ever been conducted at Rocky Flats. In addition to plutonium, smaller amounts of americium are found in association with plutonium. Americium is formed from the decay of plutonium and is an important component of fallout. Uranium is a naturally-occurring radioactive material found at varying concentrations throughout the United States. The Front Range of Colorado typically has relatively high and variable natural uranium in its soil compared with much of the rest of the United States. Thus all soils contain measurable amounts of background levels of plutonium, americium, and uranium from fallout and natural sources.

In addition to natural background levels and fallout sources of plutonium, americium, and uranium, the Rocky Flats Plant has used these materials in the plant's past operations. Although sample results are reported for plutonium, americium, and uranium; plutonium is considered the most important contaminant of concern in areas offsite of Rocky Flats. One purpose of the environmental investigation is to determine what range of concentrations of plutonium, americium, and uranium can be expected in this geographic area from background sources and what amounts, if any, of these materials in soil might be attributed to past Rocky Flats activities. We greatly appreciate your assistance in helping us develop this information.

CORRES. CONTROL X X  
ADMN RECORD/080 X 2  
PATS/T130G

Reviewed for Addressee  
Corres. Control RFP

11-4-94  
DATE

BY

Ref Ltr. #

DOE ORDER # 5400.1

Mr. & Mrs. Anderson  
94-DOE-10836

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The analysis of soil samples from your property include measurements of the radioactivity from three elements: plutonium (Pu), americium (Am), and uranium (U). The forms or "isotopes" of the elements include  $^{239/240}\text{Pu}$ ,  $^{241}\text{Am}$ ,  $^{233/234}\text{U}$ ,  $^{235}\text{U}$ , and  $^{238}\text{U}$ . The superscript number preceding the element symbol describes the total number of protons and neutrons in the nucleus of the element atom and indicates the isotope of the element. These are the primary isotopes contributing to background radioactivity and Rocky Flats Plant sources of plutonium, americium, and uranium.

Two different sampling methodologies were used to sample your property. Both methodologies sampled the top surface of the soil but at slightly different depths. The Colorado Department of Health (CDH) method samples the top 1/4 inch of soil. The Rocky Flats Plant (RFP) method samples the top 2 inches of soil. Results from both methods are reported in enclosure 1. When results from the two sampling methods are statistically compared, no difference is found. We are reporting results for both methods for completeness. Soil sample results are expressed in units of picocuries per gram of soil (pCi/g). A curie is a unit for measuring radioactivity based on the rate of radioactive disintegration. Approximately sixteen grams of plutonium will produce 1 curie of radioactive disintegration. A picocurie is a fraction of a curie equal to one-trillionth of a curie.

You will notice in Enclosure 2 that the background concentrations of these radionuclides are highly variable. Deposition of radioactive fallout is not uniform, therefore the concentration found in soils is also not uniform. Large variations in concentration can occur even within a small geographic area. Fallout deposition is greatly influenced by the weather, particularly rain and snow distribution and wind patterns. Thus fallout levels increase with altitude, most likely because of higher precipitation. These factors make assessing possible offsite impacts, in the low background concentration range, from the Rocky Flats operation very difficult.

To understand the analysis results from your property, comparison with existing background concentrations is valuable. Enclosure 2 reports background levels for Pu, Am, and U. Two sources of background results are listed: measurements by DOE from an area northwest of the Rocky Flats Plant and measurements by the Colorado Department of Health obtained from eastern Colorado. The Colorado Department of Health uranium analysis only measured the total uranium metal content, or sum of the isotopes, in the soil rather than specific isotopes reported in DOE's background measurements. Plutonium is our primary contaminant of concern in the areas offsite from Rocky Flats. The soil concentration level from your property falls within the expected local background concentration range of 0.007 - 0.100 pCi/g of  $^{239/240}\text{Pu}$ .

Your surface soil sample results will be combined with other soil, sediment, air, surface water, groundwater, and biological sample analysis results to assess the effect of Rocky Flats on offsite areas. A Remedial Investigation Report is in development to determine the nature and extent of offsite contamination and assess the potential human health risk. A draft report will be prepared by the middle of next year but will require extensive review cycles by the Environmental Protection Agency and Colorado Department of Health before final approval.

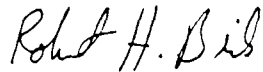
Mr. & Mrs. Anderson  
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Please review the enclosed information. If you should have any questions at all, please call me, Robert Birk at 966-5921. I will make whatever arrangements are necessary to answer your questions or concerns. Again, we extend our appreciation for your assistance in this project.

Sincerely,

A handwritten signature in cursive script, reading "Robert H. Birk".

Robert H. Birk  
Operable Unit 3 Program Manager  
Environmental Restoration

Enclosure

cc w/Enclosure:  
S. Schiesswohl, PIMD, RFFO  
M. Roy, OCC, RFFO  
M. Buddy, EG&G

cc w/o Enclosure:  
B. Brainard-Jordan, CED, RFFO  
S. Stiger, EG&G

ENCLOSURE 1

Anderson  
PT 14692  
94-DOE-10836

**Results of Surface Soil Sample Analysis From Your Property  
Obtained During Rocky Flats Plant OU 3 Remedial Investigation**

**RADIONUCLIDE**

	<b>Rocky Flats Sampling Method</b>	<b>Colorado Department Of Health Sampling Method</b>
<b>AMERICIUM 241</b>		
	.0100 pCi/g	.0160 pCi/g
<b>PLUTONIUM 239/240</b>		
	.0510 pCi/g	.0180 pCi/g
<b>URANIUM 233/234</b>		
	1.3000 pCi/g	1.5000 pCi/g
<b>URANIUM 235</b>		
	.1200 pCi/g	.0800 pCi/g
<b>URANIUM 238</b>		
	1.5000 pCi/g	1.3000 pCi/g

# ENCLOSURE 2

## Radionuclide Background Measurements Statewide and from the Rocky Flats Plant

### Rocky Flats Plant Background Measurements (19 Samples Obtained)

#### AMERICIUM 241

MAXIMUM	0.041 pCi/g
MINIMUM	0.000 pCi/g
AVERAGE	0.018 pCi/g

#### PLUTONIUM 239/240

MAXIMUM	0.100 pCi/g
MINIMUM	0.026 pCi/g
AVERAGE	0.055 pCi/g

#### URANIUM ISOTOPES

#### URANIUM 233,234

MAXIMUM	1.472 pCi/g
MINIMUM	0.922 pCi/g
AVERAGE	1.154 pCi/g

#### URANIUM 235

MAXIMUM	0.139 pCi/g
MINIMUM	0.011 pCi/g
AVERAGE	0.048 pCi/g

#### URANIUM 238

MAXIMUM	1.521 pCi/g
MINIMUM	0.9 pCi/g
AVERAGE	1.194 pCi/g

### Colorado Department of Health Statewide Background Measurements

#### AMERICIUM 241

NO SAMPLES FOR AMERICIUM 241  
TAKEN BY CDH

#### PLUTONIUM 239/240

Loveland	<0.008	pCi/g
Livermore	<0.007	pCi/g
Crook	<.020 +/- 0.004	pCi/g
Burlington	0.047 +/- 0.003	pCi/g
Limon	0.014 +/- 0.002	pCi/g
Springfield	<0.006	pCi/g
Walsenburg	.0044 +/- 0.005	pCi/g
Penrose	0.010 +/- 0.003	pCi/g

#### URANIUM ISOTOPES (Sum of Uranium Isotopes)

Loveland	2.6	pCi/g
Livermore	2.5	pCi/g
Crook	2.0	pCi/g
Burlington	2.4	pCi/g
Limon	2.4	pCi/g
Springfield	1.3	pCi/g
Walsenburg	1.4	pCi/g
Penrose	2.6	pCi/g

ENCLOSURE 3  
Information Sheet

- americium (Am): A radioactive metallic element that is primarily artificially produced from the decay of  $^{241}\text{Pu}$ .
- concentrations: The amount of a specified substance (plutonium, uranium and/or americium) or amount of radioactivity in a given volume or mass. At low detection limits, the values may contain uncertainty as a result of sampling and analysis variability. This uncertainty is indicated by an error factor identified by a plus or minus (+/-) value.
- curie (Ci): A curie is the traditional unit for measurement of radioactivity based on the rate of radioactive disintegration. One curie is defined as  $3.7 \times 10^{10}$  (37 billion) disintegrations per second.
- disintegration: A spontaneous nuclear transformation (radioactivity) characterized by the emission of energy and/or mass from the nucleus of an atom.
- isotopes: Forms of an element having the same number of protons in their nuclei and differing in the number of neutrons. The specific isotope is indicated by a superscript number preceding the element symbol (ie  $^{240}\text{Pu}$ )
- natural radiation: Radiation arising from cosmic sources and from naturally -occurring radioactive materials present in the soil (thorium), houses and buildings (radon), some foods and drinks (potassium), and radioactive elements naturally present in the human body (carbon).
- picocurie (pCi): A fraction of a curie:  $1 \times 10^{-12}$  Curie (.0000000000010 Curie); or one-trillionth of a curie; or 0.37 disintegrations per second.
- plutonium (Pu): A radioactive metallic element that is primarily artificially produced.
- radioactivity: The spontaneous transformation of an unstable atom into a different radioactive or nonradioactive atomic nucleus, or into a different energy state of the same atom.
- radionuclide: An atom that emits radiation.
- risk assessment: The science of estimating the potential magnitude and types of effects that may result from exposure to chemicals or other hazards in the environment.
- uranium (U): A heavy, silvery-white radioactive metallic element that is found in naturally-occurring ores.
- worldwide fallout: Radioactive debris from atmospheric weapons tests that is either airborne and cycling around the earth or has been deposited on the earth's surface.

## ENCLOSURE 4A

### PERSPECTIVE ON RADIATION<sup>1</sup>

#### INTRODUCTION

Past activities at the Rocky Flats Plant (RFP) involved handling radioactive materials and operating radiation-producing equipment. Environmental monitoring programs include monitoring for potential exposures to the public from RFP-related radiation sources. This section provides the basic concepts of radiation to assist in the understanding and interpretation of the Soil Sample Analysis Report and its other attachments.

#### IONIZING RADIATION

Many kinds of radiation exist in our environment. Visible light and heat radiating from a warm object are examples. Radioactive materials and radiation-producing equipment generates ionizing radiation which has sufficient energy to separate electrons from atoms of material. This separation process is called ionization.

Radiation producing equipment requires the use of electrical power in order for radiation to be generated. In contrast, radioactive materials will continue to emit ionizing radiation until they have undergone radioactive decay to nonradioactive, stable isotopes. The time required for a material to reach this stable state is dependent upon a materials half life. Half-life is the amount of time required for one half of the atoms of a radioactive material to experience radioactive decay.

Common types of ionizing radiation include alpha, beta, gamma, X-ray, and neutron radiation. These types all share common ionizing characteristics but differ in the ability to penetrate or pass through materials. Alpha radiation penetrates poorly and therefore can be stopped by a piece of paper or outer skin tissue. Beta radiation has low to moderate penetrating ability. Gamma, X-Ray, and neutron radiation usually have much greater penetrating ability enabling it to pass through skin tissue.

When ionizing radiation is absorbed in living tissues, it can cause damage from the ionization process. In some instances, protective measures are required at RFP to minimize the amount of ionizing radiation to which an employee might be exposed.

#### Radiation Dose

The biological dose effect of ionizing radiation is called radiation dose. The radiation can be from a penetrating radiation source located outside of the body (external radiation) or from radioactive materials taken into the body (internal radiation). In the United States, radiation dose is measured in the unit called rem or millirem (1 rem = 1,000 millirem). A rem is a unit of biological dose that expresses biological damage on a common scale. The effective dose equivalent (EDE) is a means of calculating radiation dose. EDE takes into account the total health risk estimated for cancer mortality and serious genetic defects from radiation exposure

## ENCLOSURE 4A(continued)

regardless of which body tissues receive the dose or the sources or types of ionizing radiation producing the dose.

Annual, natural occurring EDE to a typical resident of the Denver metropolitan area, based on current published reports, is about 350 mrem/yr. By comparison, the estimated total average EDE for a member of the United States population from natural sources is about 300 mrem/yr.

### SOURCES OF RADIATION

All living things are exposed to naturally occurring ionizing radiation. However, since the discovery of radiation and radioactive materials at the beginning of this century, we may significantly increase our exposure through the use of artificially produced or enhanced sources of radiation. Sources of radiation are described in the text below and shown graphically in attachment 4B.

#### Natural Sources

Naturally occurring sources are the greatest contributor to radiation exposures for people living in the United States. Sources of natural background radiation include cosmic radiation from space and secondary materials (cosmogenic nuclides) created when cosmic radiation enters our atmosphere. Another source is naturally occurring radioactive materials originating from the earth's crust, referred to as primordial nuclides. These materials can contribute to both internal and external radiation exposure. Radon, for example, a radioactive gas derived from uranium, is a major contributor to internal radiation exposure as a result of inhalation inside buildings.

#### Medical Sources

Ionizing radiation is used in medicine for diagnosis and treatment of many medical conditions. Medical sources account for the largest radiation doses to the public from artificially produced sources of radiation. The average EDE to a member of the United States population from medical sources is about 50 mrem/yr. However, individual doses from this source vary.

#### Consumer Products Sources

Consumer products are the second largest contributor to radiation dose to the United States population from artificially produced or enhanced sources. Consumer products, including tobacco, smoke detectors, television sets, and X-ray bagging systems all have ionizing radiation associated with them.



## ENCLOSURE 4A(continued)

### Other Sources

Naturally occurring, medical, and consumer product sources contribute over 99 percent of the average radiation dose that a person living in the United States receives each year. Other sources include occupational exposures, residual fallout from past atmospheric weapons testing, the nuclear fuel cycle, and miscellaneous sources. Combined, these other sources contribute less than 1 percent of the average radiation dose to a person living in the United States.

1. EG&G. 1992. *Rocky Flats Plantsite Environmental Report for 1991: January through December 1991*, EG&G, Rocky Flats Plant, Golden, Colorado.

Contribution of Various Sources to the Total Average Dose to the United States Population

